

Incident Description: On April 12, 2011, at 10:40 PM, there was a flameout in the kiln that enabled hydro-carbons to move beyond the secondary combustion chamber into the boiler. Initial indications are that the hydrocarbons ignited and traveled through the boiler with increasing velocity from the turbulence created by the boiler tubes and chains. An explosion (deflagration) occurred between boiler evaporators two and three. No personnel were injured in this event.

Incident Investigation: It is still ongoing.

Team: Frank Murray, Kevin Lloyd, Christine Shorokey, Steve Lorah, John Avdellas, Don Ketchum of Baker Risk, Carrie Beringer and John Peterka. Chris Maheu joined us on April 13. We extended other invitations to Winde Hamrick and Ralph Roper. Ralph will be at HWTI on April 20.

Witness Reports: Three operators stated that the kiln was running extremely well until the incident. They mentioned that they had been running hotter temperatures to burn out a “donut” in the kiln. Control room personnel heard a rumbling noise. Leon Huff and Brian Peters heard a boom; Todd Desarro heard both.

Initial Plant Observations and Assessments:

- No waste or ash residue left the facility fence line.
- Ash on the ground varied in depth from an inch to over three inches. The area of ash on the ground extended from the front of the kiln (east) to the spray dryer (west) and north to the residue box trailer scales as well to the south road.
- Much of the ash/slag was tan and fine like sand.
- Some of the slag debris was extraordinarily large.
- There was an 8-foot gap in the bottom and 14” gap at the top of boiler to spray dryer ductwork. The five ton duct was resting on the ESP.
- We lost 20” to 30” of water in the slag quench tank.
- Two incinerated drums were on the ground outside the slag conveyor.

Waste Feeds:

At the time of the incident we were feeding loose packs, ash/debris from an army depot, P&G non-hazardous carbon, Coolidge common plant wastes, and non-hazardous lab wastes. The other feed mechanisms included the DuPont high boiler at 900 to 1,000 pounds per hour, the sludge lance at 4,000 pounds per hour, and 4,000 pounds per hour of bulk crane charges (refinery solids and bulk debris). There was no apparent feed anomaly.

Since the army PBX stream was so new, we quarantined the remaining drums until after concluding our investigation. We also contacted DuPont to ask them if they had recently changed their high boiler chemistry.

Preservation of Evidence:

- We collected two 5-gallon buckets of slag samples and three jars of ash samples.
- We placed the two drums that were ejected from the slag quench tank on a pallet and stored them in the Slag Canopy.
- We locked down two slag trailers. Trailer 4182 was being filled at the time of the incident and a second trailer 4180 contained the remaining run out from the kiln. We dumped 4182 in front of the pits and examined all of the contents. We also pulled out drums from 4180 for closer examination.
- After the system cooled, we took samples from the front wall, kiln, SCC, boiler hoppers, and slag-quench water. We also collected lance, tank, kiln brow, bulk solid, slag, “donut”, and trailer 4182 “white sand” samples. We have a 5-gallon bucket of “donut” material set aside for Ralph Roper.

Operational Parameters:

We are currently trending all process variables, including, but not limited to: Temperature, Pressure, Flow rates, etc. The pressure trending is complete and all pressure profiles are very similar to the December 22, 2010 incident. Additionally, once the April 12 event trending is complete the same work will be performed for the January 16 overpressure for comparison of events.

Equipment Damage:

- The expansion joint at the boiler to spray dryer duct area was destroyed.
- According to Steve Schnaubelt of Comtech, the pressure moved the boiler to spray dryer duct approximately 8-feet from its normal anchored position.
- The second and third boiler evaporators sustained the heaviest impact from the deflagration. The north and south walls in the boiler were concaved in the outward direction approximately 12' up vertically from the bottom of the tubes. The deflection is estimated at approximate 1.0' out on each wall at the widest point and runs the entire horizontal length of the boiler. The deflagration moved the tubes in the third bank to the west approximately 20 degrees. The clips holding the header pipe (located directly downstream of the third evaporator) gave way and the chains were suspended from the south side and draped in the westward direction. Many of the tube clips in all three evaporators were bent.

External support beams bent north and south. The structural engineer inspected and determined no corrective action was needed except for the buck stays.

- There is no damage to the kiln or its refractory.
- The SCC south wall was bowed slightly but not enough to compromise the unit or its performance. Steve Schnaubelt reported that the north wall was already bowed from some previous incident and this incident caused the south wall to bow out.
- Assessments of the ESP and slag quench tank are pending; examination will be made early next week.

Theories:

1. A drum fed caused a boiling liquid expanding vapor explosion (Bleve).
2. A massive ash fall caused a steam explosion.
3. There was a vapor dust explosion in the SCC.
4. Unburned hydro-carbons channeled through the SCC and deflagrated downstream in the boiler.
5. Molten slag fell from the kiln into the slag quench.
6. Slag build-up in the SCC was loosened by the high boiler stream and then eventually fell into the slag quench.
7. Change in SCC performance due to new CPT operating parameter limits.
8. The combination of items 2 and 4.
9. A brow fell from the kiln and hit the slag quench.

Note to Item #7 – *current MACT OPLs for low temperature in the kiln went from 1,760°F to 1,718°F and the SCC went from 1,795°F to 1,747°F. The reasons for the changes were to extend refractory life and to use less fuel. Actual operating temperatures are reported to be higher and will be quantified once the temperature trending is complete.*

Methodologies:

- We are in the process of attempting a systematic approach that will list criteria that can either affirm or discount the theories listed above. This approach requires additional data that is currently being pulled.
- We intend to call Jansen on Monday to have them model various scenarios of our incineration train to determine what can be done to prevent a reoccurrence. We used Jansen in the past to help us with MACT THC emission reduction. Jansen can tell us how the SCC behaves with modifications to operating parameters, geometry, etc.
- We intend to revisit prior incidents to determine any correlation between this event and those in the past.

Data Collection and Photos:

- Steve Lorah is examining all waste streams fed 1-hour and 45 minutes before and up to the incident.
- Christine Shorokey is scrutinizing and charting all process parameters for the April 12 event, and then for the January 16 event for comparison. Charting for the December 22 event was completed at that time and is also being compared to the aforementioned events.
- Plant cameras recorded frames of the front wall, south road, slag conveyor, etc.
- Leon Huff snapped photos on the evening on April 12; Christine Shorokey, Polly Kaminsky and Bob Buchheit have taken additional photographs. Christine is the data, photo and video gatekeeper.
- Gary Jones will analyze DCS alarm data on Monday.

Repairs:

Comtech boilermakers, scaffolding personnel, and a crane service were mobilized on April 13.

- After assessing the project, Bob Buchheit and Comtech secured the duct work.
- On Thursday evening Bob Buchheit and boilermakers entered the Boiler. Afterwards Bob contracted the services of a structural engineer to assess the integrity of the structural steel.
- The structural engineer's parting words yesterday were he wanted to check one item in the code but thought, except for the buck stays, the steel would be fine as there was no load bearing structural damage.
- The expansion joint channels on the boiler side must be replaced.
- Comtech is working two, 12-hour shifts to repair the duct work and the boiler.
- Bob stated under a best-case scenario that he would be ready to heat the incinerator up on Wednesday, April 20.

Insurance:

Bill McDaniel and John Peterka agreed to defer to the Tobias experts on whether to file a claim or not. After John Peterka explained the extent of our duct work damage to Nick Rutigliano, John Wolfe and Dan Suiters, Nick advised that he would put HWTI's insurance carrier on notice. John Peterka received a call later that afternoon from Chartis' adjuster, Phil Skender. Phil Skender and a colleague (an engineer) will be at HWTI on Monday at 10:30 AM.

Milestones:

We will not resume operations until after we complete a process hazard analysis and/or conduct a pre-startup safety review (PSSR).

Due to the complexity of the incident, the investigation will extend beyond the April 20 start-up. Our Baker Risk explosion expert stated he needed two to three weeks to complete his report.

Customer Deliveries:

Most loads were cancelled from April 14 through the 22 due to limited storage capacity. Presently we are using the temporary, OEPA approved, storage area at HWTI. We are also using the 10-day facility at Whan Construction.

Local Newspaper:

The East Liverpool Review contacted Raymond Wayne and then printed the material Raymond provided on April 14, 2011.